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(54)【発明の名称】信号分離方法および受信装置

(57)【要約】
【課題】ＭＩＭＯ通信システムに用いられる、受信信号間の相関値に応じて適切な信号処理を逐次的に施し、伝送品質を向上させた信号分離方法を提供する。
【解決手段】送信情報系列毎に伝搬路の伝達特性を推定し、推定した伝達特性から送信情報系列毎に受信信号間の相関を計算して相関値の小さい情報系列信号を順にランク付けをし、受信信号に含まれる情報系列のうち、ランクの最も小さい情報系列を希望情報系列とし、希望情報系列の信号を抽出し、希望情報系列の受信信号レプリカを生成し、受信信号から希望情報系列の受信信号レプリカを減算し、受信信号レプリカを減算した信号を次のランクの情報系列の抽出入力信号とし、次のランクの情報系列の希望情報系列の信号を抽出する過程を繰り返して受信信号から全ての情報系列の信号を順に抽出する。
【選択図】図４

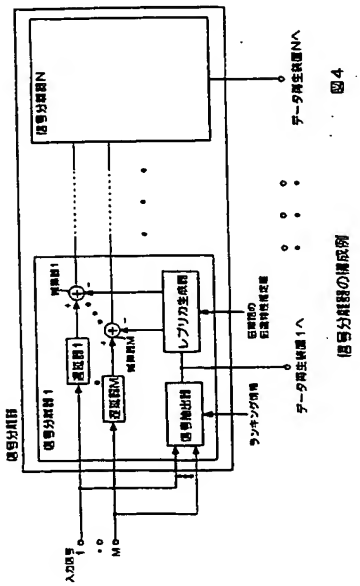


図４

【特許請求の範囲】
【請求項１】
複数の送信アンテナから送信される情報系列信号を複数の受信アンテナで受信し、受信信号から各情報系列信号を分離する信号分離方法において、
送信情報系列毎に伝搬路の伝達特性を推定し、推定した伝達特性から送信情報系列毎に受信信号間の相関を計算して相関値の小さい情報系列信号を順にランク付けをし、
受信信号に含まれる情報系列のうち、上記ランクの最も小さい情報系列を希望情報系列とし、希望情報系列の信号を抽出し、希望情報系列の受信信号レプリカを生成し、受信信号から上記希望情報系列の受信信号レプリカを減算し、受信信号レプリカを減算した信号を次のランクの情報系列の抽出入力信号とし、次のランクの情報系列の希望情報系列の信号を抽出する過程を繰り返して受信信号から全ての情報系列の信号を順に抽出することを特徴とする信号分離方法。
【請求項２】
複数の送信アンテナから送信される情報系列信号を受信する複数の受信アンテナと、受信信号から各情報系列信号を分離する信号分離装置を備えた受信装置において、
信号分離装置は、送信情報系列毎に伝搬路の伝達特性を推定する伝搬路推定器と、推定された伝達特性から送信情報系列毎に受信信号間の相関を計算する相互相関測定器と、希望情報系列を受信信号から抽出する信号分離器を多段接続した信号分離器で構成され、
相互相関測定器で得られた各情報系列の相関値を参照し、相関値の小さい情報系列の信号から順にランク付けする判定器と、信号分離器の入力信号に含まれる情報系列のうち、上記ランクの最も小さい情報系列を希望情報系列とし、希望情報系列の信号を抽出する信号抽出器と、希望情報系列の受信信号レプリカを生成するレプリカ生成器と、信号分離器入力信号から上記受信信号レプリカを減算する減算器と、減算器の出力を後段の信号分離器の入力とする過程を各段の信号分離器で行い、受信信号から全ての情報系列の信号を順に抽出することを特徴とする受信装置。
【請求項３】
請求項２に記載の受信装置において、
前記入力信号を所定値遅延させて減算器の入力信号とするる遅延器を備えたことを特徴とする受信装置。
【請求項４】
請求項２又は３に記載の受信装置において、
前記信号分離装置を複数備え、信号分離装置は各受信信号を形成するパス単位で受信信号から信号抽出を行い、全ての情報系列の信号を分離し、パス毎に分離された各情報系列の信号を合成する合成回路を備えたことを特徴とする受信装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、複数の送受信アンテナを用い、同一キャリア周波数で複数の異なる情報系列の信号を同時伝送する無線通信方法に用いられる信号分離方法及び受信装置に関し、各情報系列をその受信信号間の相関の小さい順にランキング（順位付け）し、ランキングが小さい情報系列の信号から順に信号分離を行ない、信号分離度を向上させる信号分離方法及び受信装置に関する。
【０００２】
【従来の技術】
同一キャリアでダイバーシチ受信し、全ての情報系列の信号を分離する通信方法が検討されている。この送受信アンテナ間に形成されるチャネルはＭＩＭＯ（Ｍｕｌｔｉ－Ｉｎｐｕｔ　Ｍｕｌｔｉ－Ｏｕｔｐｕｔ）チャネルと呼ばれ、チャネル間が低相関である場合、高い周波数利用効率を実現できる。
しかし、ある情報系列の信号にとって、同一帯域を共有する他の情報系列の信号は同一チャネル干渉となる。従って、受信装置では、全ての情報系列を精度よく分離することが必

須となる。
ダイバーシチ受信方式は、受信信号に含まれる（ダイバーシチ受信信号数－１）の干渉信号と希望情報系列の信号を分離できる特徴をもつ。また、干渉信号数が減るごとに希望情報系列の信号の信号分離精度が上がり、さらに、ダイバーシチ利得が得られることから伝送品質が向上する。
しかし、送受信アンテナ間に形成されるチャネル間の相関は、伝搬環境に依存する。例えば、移動局、基地局間が見通し内通信環境となると、受信信号間の相関は高くなる。これは、ダイバーシチ受信信号数が減ったことと等価的であり、この場合、受信信号中に希望情報系列の信号の他に（ダイバーシチ受信信号数－１）の干渉信号が含まれている時には、信号分離度が著しく劣化する。

【０００３】
従来のＭＩＭＯ通信システムにおける信号分離方法の概要は、送信信号及び多数の干渉信号を含む多数の信号が各受信器により受信され、受信された各信号は、重みで重み付けされて多数の重み付け信号が生成され、重み付けされた信号のうちの１つ以上が組み合わされて、１つ以上の推定された送信信号を得るものである（例えば、特許文献１　参照。）。このようにして各干渉信号を実効的に除去することができる。

【０００４】
【特許文献１】
特開２００２－８４２６０号公報（（要約）（解決手段））

【０００５】
【発明が解決しようとする課題】
複数の受信アンテナにおける受信信号間の相関が小さい情報系列の信号は、受信信号中に干渉となる信号がある場合においても、ダイバーシチ受信特性により精度よく分離ができる。また、その伝送品質はダイバーシチブランチ数（アンテナからの入力信号数）の増加により向上する。しかし、送受信アンテナ間に形成されるチャネル間の相関は周囲の地物や建物などの環境に依存する。従って、常に必要なダイバーシチ受信信号数を確保することは困難である。受信信号間の相関が大きい複数の受信信号を有効的に利用し伝送品質を向上させる技術として、アダプティブアレー技術がある。この技術では、干渉信号の到来方向にヌルを形成することで分離が可能である。また、希望信号のみの場合、そのＳＮＲを向上させることができる。一般に移動体通信環境で観測されるフェージングによる補償が難しいため、ダイバーシチ受信方式ほど特性は向上しない。

【０００６】
本発明では、ＭＩＭＯ通信システムにおいて、各情報系列の受信信号間の相関が小さい情報系列からダイバーシチ受信特性により順に信号抽出を行う。さらに、抽出された情報系列の信号の受信レプリカを順次、受信信号から減算する。これにより、受信信号間の相関が大きい情報系列の信号を処理する際には、受信信号間の相関が小さい情報系列の信号は処理対象となる信号から既に除去されているため、伝送品質が向上する。受信信号間の相関値に応じて適切な信号処理を逐次的に施し、全てのユーザ情報を分離する受信装置の構成法を提供する。

【０００７】
【課題を解決するための手段】
本発明では、上記請求項により上記課題を解決する。
請求項１記載の発明によれば、複数の受信アンテナで受信した信号から、伝搬路における各情報系列の伝達特性を推定する。推定された伝達特性から情報系列毎に受信信号間の相関を演算する。そして、受信信号間の相関値が小さい情報系列から順にランク付けを行う。
多段構成により各情報系列信号の抽出を行い、上記ランクの小さい情報系列から順に各段で信号抽出を行う。また、各段では、抽出対象となった情報系列の受信レプリカを生成し、入力信号から、受信レプリカを減じ、次段の信号分離器の入力信号とする。各段における上記動作の繰り返しにより、アンテナ受信信号に含まれる全ての情報系列の信号が分離

される。受信信号間の相関の小さい情報系列の信号群はダイバーシチ受信特性により分離され、受信信号間の相関が大きい情報系列の信号群は自由度の高いアダプティブアレー受信特性により分離する。

【０００８】

請求項２記載の発明によれば、複数の送信アンテナから送信される情報系列信号を受信する複数の受信アンテナと、受信信号から各情報系列信号を分離する信号分離装置を備え、信号分離装置は、送信情報系列毎に伝搬路の伝達特性を推定する伝搬路推定器と、推定された伝達特性から送信情報系列毎に受信信号間の相関を計算する相互相関測定器と、希望情報系列を受信信号から抽出する信号分離器を多段接続した信号分離器で構成され、相互相関測定器で得られた各情報系列の相関値を参照し、相関値の小さい情報系列の信号から順にランク付けする判定器と、各信号分離器の入力信号に含まれる、情報系列のうち、上記ランクの最も小さい情報系列を希望情報系列とし、希望情報系列の信号を抽出する信号抽出器と、希望情報系列の受信信号レプリカを生成するレプリカ生成器と、信号分離器入力信号から上記受信信号レプリカを減算する減算器と、後段の信号分離器の入力とする過程を各段の信号分離器で行い、受信信号から全ての情報系列の信号を順に抽出する。

【０００９】

請求項３記載の発明によれば、信号分離器の入力信号と生成された受信信号レプリカ間の時間的な整合を取るため、信号分離器入力信号を一定時間遅延させる遅延器を備える。

【００１０】

請求項４記載の発明によれば、信号分離装置は複数配置される。そして、パス単位で信号分離処理が行われる。パス単位で分離された各情報系列の信号は、パス遅延が補償されたのち、合成される。

【００１１】

【発明の実施の形態】

本発明の実施の形態について図面を参照して説明する。

図１は本発明の受信装置が用いられる通信系の一例を示すブロック図である。

送信装置は、Ｎ系統の情報系列をＮ系統の送信器によってＮ系統の送信アンテナから送信する。この際、各送信装置では同一キャリア周波数を用いる。従って、各送信信号は空間中を同一周波数帯域で伝送される。

受信装置では、まず、Ｍ系統の受信アンテナで受信した信号をＭ系統のＲＦ装置によって処理し、信号分離装置へ入力する。信号分離装置では、空間中を同一周波数帯域で伝送された各情報系列の信号を全て分離し、Ｎ系統のデータ再生装置で情報系列ごとにデータ再生が行われる。データの再生とは、復調や復号化および判定作業を指す。

【００１２】

図２に本発明による信号分離器の構成例を示す。

Ｍ系統の受信信号からＭ系統のＲＦ装置で、ベースバンド帯もしくはＩＦ帯にダウンコンバートされたＭ系統の信号を入力とする。また、相互相関測定器１～ＮではＭ系統の入力信号から情報系列１～Ｎ毎に受信ブランチ間相関（受信アンテナからの入力信号間の相関）を測定する。得られた相関値は判定装置に送られる。判定器では、各情報系列を相関値の小さい順にランク（順位）付けをし、メモリに格納する。そして、ランキング情報を信号分離器へ伝送する。

【００１３】

図３に相互相関測定器の構成例を示す。

入力信号１～Ｍから情報系列１～Ｎ毎に伝搬路の伝達特性を推定する伝搬路推定器と伝搬路推定結果をもとに受信系統間の相関を計算する相関演算部で構成される。伝搬路推定は、図に示すように各送信された情報系列１～Ｎ毎にそれぞれ推定を行う。この処置は逐次的に行われるが、送信側から受信装置で既知である各情報系列の参照信号を送信し、推定を容易にする方法などを用いてもよい。送信アンテナｎと受信アンテナｍ間の伝搬路の伝達特性をＰ（ｎ，ｍ）とする。図３において、対応する伝搬路の推定伝達特性をＰ’（ｎ，ｍ）とする。情報系列ｎ用の相関演算器には、ｎ番目（情報系列ｎ）の送信アンテナと

m個の受信アンテナ間に形成された伝搬路の伝達特性推定値P'（n，1），・・・，P'（n，m）を入力し、これらの相関を求める。

【００１４】

図４に本発明による信号分離器の構成例を示す。

信号分離器はＮ段の信号分離器から構成される。各信号分離器は、信号抽出器、レプリカ生成器そして遅延器と減算器で構成される。上記、相互相関測定器より得られたランキング情報を元に相関値が小さい情報系列の信号から信号分離器１の信号抽出器、信号分離器２の信号抽出器、・・・で信号抽出が行われる。抽出された情報系列の信号から、伝搬路の伝達特性推定値などを用いて、対応する受信レプリカをを生成する。この受信レプリカは各段の信号分離器入力信号から減算され、次段の信号分離器へ入力される。この際、信号分離器入力信号と、受信レプリカ信号の時間的な整合を合わせる目的で、信号分離器入力信号を遅延器により一定時間（すなわち、信号抽出器とレプリカ生成器の処理時間）遅延させる。

【００１５】

図５に本発明による信号抽出器の構成例を示す。

信号抽出器は、タップ係数制御器（重み演算器）によって求められたタップ係数を信号分離器入力信号１～Ｎにぞれぞれ乗算する（重み付けする）乗算器と、乗算器１～Ｍの出力を合成する合成器、タップ係数を制御するために用いられる各情報系列の参照信号を各段において上記相互相関測定装置の測定結果に基づいた情報系列のランキング情報により対応する参照信号を選択する参照信号選択器で構成される。タップ係数制御アルゴリズムの例としては、信号分離器出力信号と参照信号の差の自乗値を最小とするようにタップ係数を制御する方法が一般的である。この演算はＬＭＳ（最小平均自乗）もしくはＲＬＳ（再帰的最小自乗）アルゴリズムを用いることで装置化が可能である。

【００１６】

図６に本発明によるレプリカ生成器の構成例を示す。

図６では、ｎ番目の送信器から送信された信号（情報系列ｎ）の各受信アンテナにおける受信信号レプリカの生成を示す。伝搬路推定器によって求められた伝搬路の推定伝達特性であるP'（n，1），・・・，P'（n，m）を送信された情報系列ｎにそれぞれ乗算することで、受信信号レプリカを生成する。

【００１７】

図７に本発明による受信装置内部に配置される信号分離装置の他の構成例を示す。図７は、ｐ個の信号分離装置を配置した実施例である。

移動通信環境では、通常受信信号は複数の経路を経て任意の遅延時間をもち受信アンテナへ到来する。これをマルチパス伝搬と呼ぶ。各パスが時間的に分離可能で、独立な場合、これらを合成することで時間ダイバーシチ効果を得ることができる。図７では、遅延回路に各パスの遅延時間を設定し、各信号分離装置は上記の動作を行う。ｐ個の信号分離装置はそれぞれ、上記の手段により送信情報系列の信号を出力し、情報系列ごとに合成回路において合成される。ここで、合成回路では、最大比合成、同相合成、選択合成などを代表とする合成手法が用いられる。

【００１８】

図８に本発明と従来法による受信系統毎の平均受信ＳＮＲに対する誤り率ＢＥＲ特性を示す。

従来法では、受信信号間の相関が高い情報系列の信号が精度良く分離できないため、誤り率を示す曲線はＳＮＲを増加しても改善されない特性を示していた。これに対し本発明による方法により、ダイバーシチ受信特性により、受信信号間の相関が小さい情報系列の信号を予め分離し受信信号から減じることで受信信号間の相関が高い情報系列の信号の伝送特性を向上させることができる。

【００１９】

【発明の効果】

以上説明したように、本発明は、各情報系列の受信信号間の相関を測定し、相関値の小さ

い情報系列の信号から順に情報系列信号の抽出を行い、また、各情報系列の信号を抽出後に抽出された情報系列の受信信号レプリカを生成し、受信信号から減算する処理を順次、繰り返すことにより、信号分離度を向上させ、ＳＮＲの向上による伝送品質の改善を図ることができる。

【図面の簡単な説明】

【図１】本発明の受信装置が用いられる通信系を示す図。

【図２】信号分離装置の構成例を示す図。

【図３】相互相関測定器の構成例を示す図。

【図４】信号分離器の構成例を示す図。

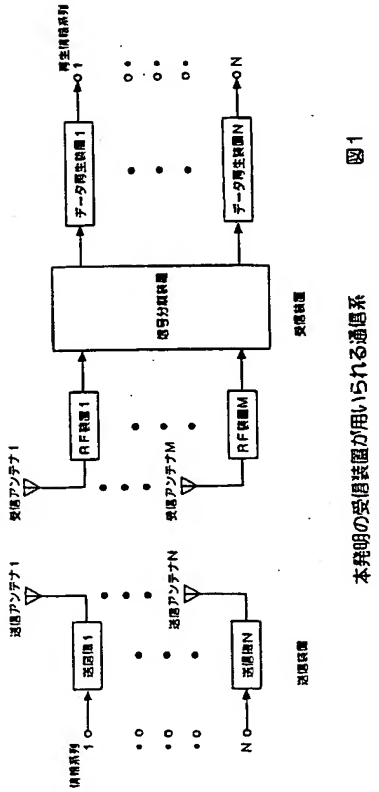
【図５】信号抽出器の構成例を示す図。

【図６】レプリカ生成器の構成例を示す図。

【図７】信号分離装置の他の構成例を示す図。

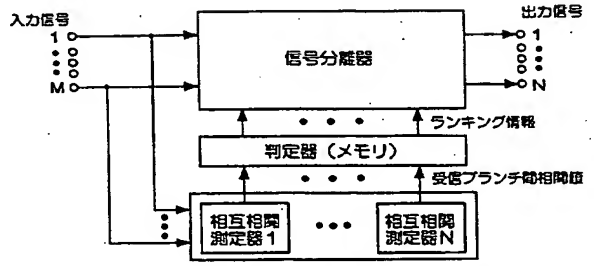
【図８】受信系統毎の平均受信ＳＮＲに対する誤り率ＢＥＲ特性を示す図。

【図１】



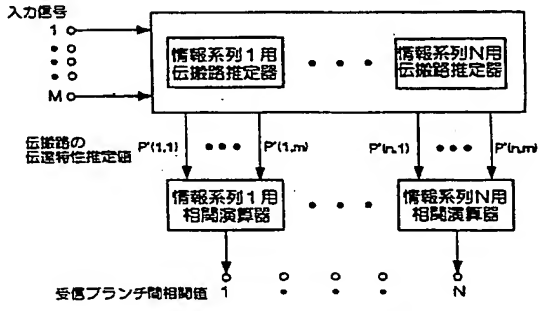
本発明の受信装置が用いられる通信系　図1

【図２】



信号分離装置の構成例　図2

【図３】



相互相関測定器の構成例　図3

【図４】

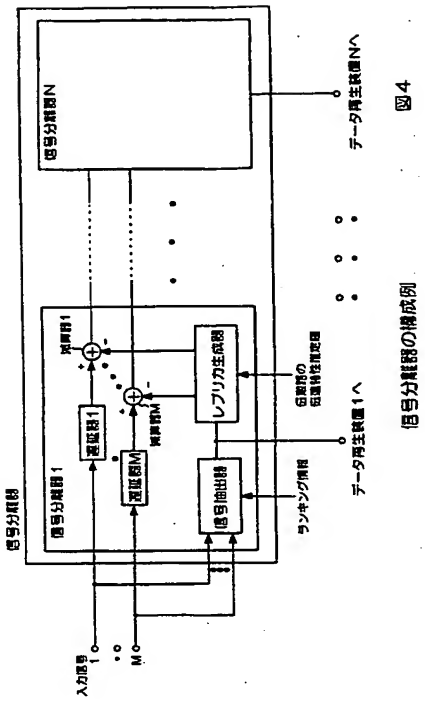
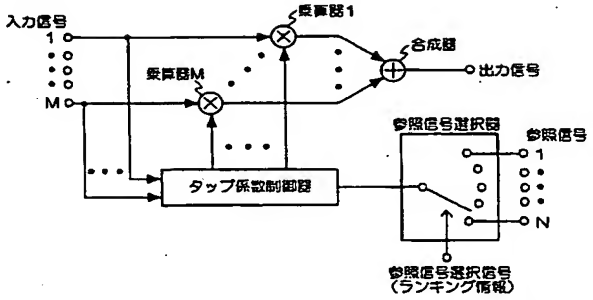


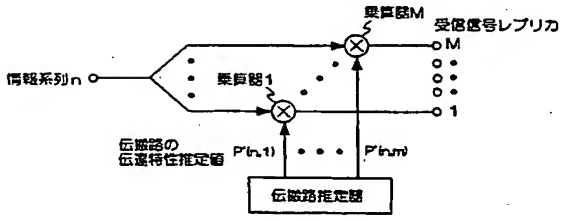
図４ 信号分離器の構成例

【図５】



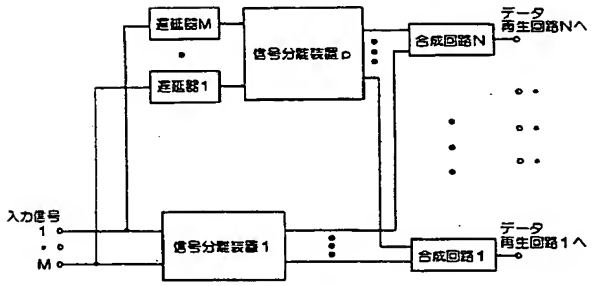
信号抽出器の構成例 図５

【図６】



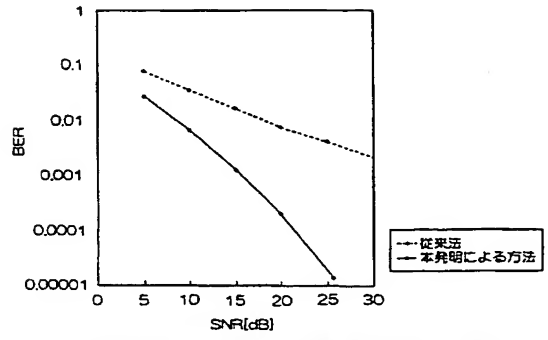
レプリカ生成器の構成例 図６

【図７】



信号分離装置の他の構成例 図７

【図８】



受信系統毎の平均受信SNRに対する誤り率BER特性 図８

フロントページの続き

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Ｆターム(参考) 5K022 FF00
5K059 CC03　CC07

JAPANESE [JP,2004-096603,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1]
In the signal separation approach of two or more receiving antennas receiving the information sequence signal transmitted from two or more transmitting antennas, and separating each information sequence signal from an input signal,
The transfer characteristics of a propagation path are presumed for every transmit information sequence, correlation between input signals is calculated for every transmit information sequence from the presumed transfer characteristics, and an information sequence signal with a small correlation value is ranked in order,
The smallest information sequence of the above-mentioned rank is made into the information sequence of choice among the information sequences included in an input signal. Extract the signal of the information sequence of choice and the input-signal replica of the information sequence of choice is generated. The signal which subtracted the input-signal replica of the above-mentioned information sequence of choice from the input signal, and subtracted the input-signal replica is made into the extract input signal of the information sequence of the next rank. The signal separation approach characterized by repeating the process in which the signal of the information sequence of choice of the information sequence of the next rank is extracted, and extracting the signal of all information sequences from an input signal in order.
[Claim 2]
In two or more receiving antennas which receive the information sequence signal transmitted from two or more transmitting antennas, and the receiving set equipped with the signal decollator which separates each information sequence signal from an input signal,
A signal decollator is constituted by the signal eliminator which made multistage connection of the propagation path presumption machine which presumes the transfer characteristics of a propagation path for every transmit information sequence, the cross-correlation measuring instrument which calculates correlation between input signals for every transmit information sequence from the presumed transfer characteristics, and the signal eliminator which extracts the information sequence of choice from an input signal,
The judgment machine ranked sequentially from the signal of an information sequence with a small correlation value with reference to the correlation value of each information sequence acquired with the cross-correlation measuring instrument, The signal extractor which makes the smallest information sequence of the above-mentioned rank the information sequence of choice among the information sequences included in the input signal of a signal eliminator, and extracts the signal of the information sequence of choice, The replica generation machine which generates the input-signal replica of the information sequence of choice, and the subtractor which subtracts the above-mentioned input-signal replica from a signal eliminator input signal,
The receiving set characterized by for the signal eliminator of each stage performing the process which considers the output of a subtractor as the input of a latter signal eliminator, and extracting the signal of all information sequences from an input signal in order.
[Claim 3]
In a receiving set according to claim 2,

The receiving set characterized by having ******** which is made to carry out predetermined value delay of said input signal, and is made into the input signal of a subtractor.

[Claim 4]

In a receiving set according to claim 2 or 3,

It is the receiving set characterized by having the synthetic circuit which compounds the signal of each information sequence which performed the signal extract from the input signal in the pass unit in which two or more preparations and a signal decollator form each input signal for said signal decollator, separated the signal of all information sequences, and was separated for every pass.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
Ranking (ranking) is carried out to the small order of correlation of each information sequence between the input signal about the signal separation approach and receiving set which are used for the radio approach which transmits simultaneously the signal of an information sequence with which plurality differs by the same carrier frequency using two or more transceiver antennas, ranking performs signal separation sequentially from the signal of a small information sequence, and this invention relates to the signal separation approach and receiving set which raise signal degree of separation.
[0002]
[Description of the Prior Art]
Diversity reception is carried out on the same carrier, and the correspondence procedure which separates the signal of all information sequences is examined. The channel formed between this transceiver antenna is called a MIMO (Multi-Input Multi-Output) channel, and when between channels is low correlation, high frequency use effectiveness can be realized.
However, the signal of other information sequences which share the same band serves as cochannel interference for the signal of a certain information sequence. Therefore, in a receiving set, it becomes indispensable to separate all information sequences with a sufficient precision.
A diversity reception method has the description which can separate an interference signal [being contained in an input signal (-one diversity reception signal)], and the signal of the information sequence of choice. Moreover, since the signal sharpness of separation of the signal of the information sequence of choice goes up and diversity gain is further acquired whenever the number of interference signals becomes fewer, the transmission quality improves.
However, it depends on a propagation environment for the correlation between the channels formed between transceiver antennas. For example, if between a mobile station and a base station serves as a line-of-sight communication environment, the correlation between input signals will become high. This is as equivalent as the number of diversity reception signals having become fewer, and when the interference signal with (-one diversity reception signal) other than the signal of the information sequence of choice is included in the input signal in this case, signal degree of separation deteriorate remarkably.
[0003]
It is received by each receiver, and weighting of each received signal is carried out under the weight, many weighting signals are generated, one or more of the signals by which weighting was carried out are put together, and many signals with which the outline of the signal separation approach in the conventional MIMO communication system includes a sending signal and many interference signals obtain one or more presumed sending signals (for example, patent reference 1. reference). Thus, each interference signal is effectually removable.
[0004]
[Patent reference 1]
JP,2002-84260,A (epitome) (solution means)

[0005]
[Problem(s) to be Solved by the Invention]
The signal of an information sequence with the small correlation between the input signals in two or more receiving antennas can improve [separation] precision with a diversity reception property, when there is a signal which is interfering into an input signal. Moreover, the transmission quality improves by the increment in the number of diversity branches (the number of input signals from an antenna). However, it depends on the environment of surrounding planimetric features, a building, etc. for the correlation between the channels formed between transceiver antennas. Therefore, it is difficult to secure the always required number of diversity reception signals. There is an ADAPUDIBU array technique as a technique which uses two or more input signals with the large correlation between input signals for an effective target, and raises the transmission quality. It is separable by forming null in the arrival direction of an interference signal with this technique. Moreover, only in the case of the signal of choice, the SNR can be raised. Since compensation by phasing generally observed by mobile communication environment is difficult, a property does not improve like a diversity reception method.
[0006]
In this invention, correlation between the input signals of each information sequence performs a signal extract in order with a diversity reception property from a small information sequence in MIMO communication system. Furthermore, the receiving replica of the signal of the extracted information sequence is subtracted from an input signal one by one. In case this processes the signal of an information sequence with the large correlation between input signals, since the signal of an information sequence with the small correlation between input signals is already removed from the signal used as a processing object, its transmission quality improves. According to the correlation value between input signals, suitable signal processing is serially performed to a target, and the construction of the receiving set which separates all User Information is offered.
[0007]
[Means for Solving the Problem]
In this invention, the above-mentioned technical problem is solved by the above-mentioned claim.
According to invention according to claim 1, the transfer characteristics of each information sequence in a propagation path are presumed from the signal received with two or more receiving antennas. Correlation between input signals is calculated for every information sequence from the presumed transfer characteristics. And it ranks sequentially from an information sequence with the small correlation value between input signals.
A multistage configuration extracts each information sequence signal, and a signal extract is performed in each stage sequentially from the small information sequence of the above-mentioned rank. Moreover, in each stage, the receiving replica of the information sequence used as the candidate for an extract is generated, and from an input signal, a receiving replica is reduced and it considers as the input signal of the signal eliminator of the next step. The signal of all the information sequences included in an antenna input signal is separated by the repeat of the above-mentioned actuation in each stage. The signal group of the small information sequence of correlation between input signals is separated by the diversity reception property, and the adaptive array receiving property that a degree of freedom is high separates the signal group of an information sequence with the large correlation between input signals.
[0008]
Two or more receiving antennas which receive the information sequence signal transmitted from two or more transmitting antennas according to invention according to claim 2, It has the signal decollator which separates each information sequence signal from an input signal. A signal decollator The propagation path presumption machine which presumes the transfer characteristics of a propagation path for every transmit information sequence, and the cross-correlation measuring instrument which calculates correlation between input signals for every transmit information sequence from the presumed transfer characteristics, The judgment machine ranked sequentially from the signal of an information sequence with a small correlation

value with reference to the correlation value of each information sequence which consisted of signal eliminators which made multistage connection of the signal eliminator which extracts the information sequence of choice from an input signal, and was acquired with the cross-correlation measuring instrument, The signal extractor which makes the smallest information sequence of the above-mentioned rank the information sequence of choice among the information sequences included in the input signal of each signal eliminator, and extracts the signal of the information sequence of choice, The signal eliminator of each stage performs the process considered as the input of the replica generation machine which generates the input-signal replica of the information sequence of choice, the subtractor which subtracts the above-mentioned input-signal replica from a signal eliminator input signal, and a latter signal eliminator, and the signal of all information sequences is extracted from an input signal in order.

[0009]

In order to take the time adjustment between the input signal of a signal eliminator, and the generated input-signal replica according to invention according to claim 3, it has the delay machine to which fixed time delay of the signal eliminator input signal is carried out.

[0010]

According to invention according to claim 4, two or more arrangement of the signal decollator is carried out. And signal separation processing is performed per pass. The signal of each information sequence separated per pass is compounded after pass delay is compensated.

[0011]

[Embodiment of the Invention]

The gestalt of operation of this invention is explained with reference to a drawing.

Drawing 1 is the block diagram showing an example of the communication system for which the receiving set of this invention is used.

A sending set transmits the information sequence of N network from the transmitting antenna of N network with the transmitter of N network. Under the present circumstances, the same carrier frequency is used in each sending set. Therefore, each sending signal is transmitted in the inside of space in the same frequency band.

In a receiving set, first, the signal received with M receiving antennas is processed with M RF equipments, and is inputted into a signal decollator. In a signal decollator, all the signals of each information sequence transmitted in the inside of space in the same frequency band are separated, and data playback is performed by the data regenerative apparatus of N network for every information sequence. Playback of data points out a recovery, a decryption, and a judgment activity.

[0012]

The example of a configuration of the signal eliminator by this invention is shown in drawing 2 . With M RF equipments, M signals by which the down convert was carried out are considered as an input from M input signals at a baseband band or IF band. Moreover, in the cross-correlation measuring instrument 1 - N, the correlation between receiving branches (correlation between the input signals from a receiving antenna) is measured for every information sequence 1 - N from M input signals. The acquired correlation value is sent to judgment equipment. With a judgment vessel, rank (ranking) attachment is carried out to order with a small correlation value, and each information sequence is stored in memory. And ranking information is transmitted to a signal eliminator.

[0013]

The example of a configuration of a cross-correlation measuring instrument is shown in drawing 3 .

It consists of correlation operation part which calculates correlation between receiving networks based on the propagation path presumption machine and propagation path presumption result which presume the transfer characteristics of a propagation path for every information sequence 1 - N from input signal 1-M. Propagation path presumption presumes, respectively for every information sequence 1 each transmitted as shown in drawing - N. Although this treatment is serially given to a target, the reference sign of each information sequence which is known may be transmitted with a receiving set from a transmitting side, and the approach of making

presumption easy etc. may be used. The transfer characteristics of the propagation path between the transmitting antenna n and a receiving antenna m are set to P (n, m). In drawing 3 , the presumed transfer characteristics of a corresponding propagation path are made into P' (n, m). information — a sequence — n — ** — correlation — a computing element — **** — n — a position (information sequence n) — transmission — an antenna — m — a piece — a receiving antenna — between — forming — having had — a propagation path — transfer characteristics — estimate — P — ' (n, 1) ... P — ' (n, m) — inputting — these correlation — asking .

[0014]

The example of a configuration of the signal eliminator by this invention is shown in drawing 4 . A signal eliminator consists of signal eliminators of N stage. Each signal eliminator consists of a signal extractor, a replica generation machine and a delay machine, and a subtractor. A signal extract is performed from the signal of an information sequence with a small correlation value based on the ranking information acquired from the above and a cross-correlation measuring instrument by the signal extractor of the signal eliminator 1, the signal extractor of the signal eliminator 2, and ... From the signal of the extracted information sequence, corresponding receiving REPURIKA ** is generated using the transfer-characteristics estimate of a propagation path etc. This receiving replica is subtracted from the signal eliminator input signal of each stage, and is inputted into the signal eliminator of the next step. Under the present circumstances, fixed time amount (namely, processing time of signal extractor and replica generation machine) delay of the signal eliminator input signal is carried out with a delay vessel in order to double time adjustment of a receiving replica signal with a signal eliminator input signal.

[0015]

The example of a configuration of the signal extractor by this invention is shown in drawing 5 . A signal extractor consists of reference signal selectors which choose the reference sign which corresponds the reference sign of each information sequence used in order to control the multiplier which carries out the ******** multiplication of the tap multiplier called for by the tap multiplier controller (weight computing element) to the signal eliminator input signal 1 - N (weighting is carried out), the synthetic vessel which compounds the output of a multiplier 1 - M, and a tap multiplier in each stage using the ranking information on the information sequence based on the measurement result of the above-mentioned cross-correlation measuring device. as the example of a tap multiplier control algorithm — the square of the difference of a signal eliminator output signal and a reference sign — the approach of controlling a tap multiplier to make a value into min is common. This operation can be instrumentated by using LMS (the minimum average square) or a RLS (recursive least square) algorithm.

[0016]

The example of a configuration of the replica generation machine by this invention is shown in drawing 6 .

Drawing 6 shows generation of the input-signal replica in each receiving antenna of the signal (information sequence n) transmitted from the n-th transmitter. a propagation path — presumption — a vessel — asking — having had — a propagation path — presumption — transfer characteristics — it is — P — ' (n, 1) ... P — ' (n, m) — transmitting — having had — information — a sequence — n — respectively — multiplication — carrying out — things — an input-signal replica — generating .

[0017]

Other examples of a configuration of the signal decollator arranged inside the receiving set by this invention at drawing 7 are shown. Drawing 7 is an example which has arranged p signal decollators.

In migration communication environment, an input signal usually arrives at a receiving antenna with the time delay of arbitration through two or more paths. This is called multi-pass propagation. Each pass is disengageable in time, and when independent, the time diversity effectiveness can be acquired by compounding these. In drawing 7 , the time delay of each pass is set as a delay circuit, and each signal decollator performs the above-mentioned actuation. p

signal decollators output the signal of a transmit information sequence with the above-mentioned means, respectively, and are compounded in a synthetic circuit for every information sequence. Here, in a synthetic circuit, the synthetic technique of making representation the maximum ratio composition, inphase composition, selection composition, etc. is used.

[0018]

The error rate BER property over the average reception SNR for every receiving network by this invention and the conventional method is shown in drawing 8 .

With the conventional method, since the signal of an information sequence with the high correlation between input signals was not able to dissociate with a sufficient precision, the curve which shows an error rate showed the property which is not improved even if it increases SNR. On the other hand, by the approach by this invention, the transmission characteristic of the signal of an information sequence with the high correlation between input signals can be raised because correlation between input signals separates the signal of a small information sequence beforehand and decreases from an input signal with a diversity reception property.

[0019]

[Effect of the Invention]

As explained above, this invention measures correlation between the input signals of each information sequence. By generating the input-signal replica of the information sequence which extracted the information sequence signal sequentially from the signal of an information sequence with a small correlation value, and was extracted after extracting the signal of each information sequence, and repeating successively the processing subtracted from an input signal Signal degree of separation can be raised and an improvement of the transmission quality by improvement in SNR can be aimed at.

[Brief Description of the Drawings]

[Drawing 1] Drawing showing the communication system for which the receiving set of this invention is used.

[Drawing 2] Drawing showing the example of a configuration of a signal decollator.

[Drawing 3] Drawing showing the example of a configuration of a cross-correlation measuring instrument.

[Drawing 4] Drawing showing the example of a configuration of a signal eliminator.

[Drawing 5] Drawing showing the example of a configuration of a signal extractor.

[Drawing 6] Drawing showing the example of a configuration of a replica generation machine.

[Drawing 7] Drawing showing other examples of a configuration of a signal decollator.

[Drawing 8] Drawing showing the error rate BER property over the average reception SNR for every receiving network.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention]
Ranking (ranking) is carried out to the small order of correlation of each information sequence between the input signal about the signal separation approach and receiving set which are used for the radio approach which transmits simultaneously the signal of an information sequence with which plurality differs by the same carrier frequency using two or more transceiver antennas, ranking performs signal separation sequentially from the signal of a small information sequence, and this invention relates to the signal separation approach and receiving set which raise signal degree of separation.
[0002]

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PRIOR ART

[Description of the Prior Art]
Diversity reception is carried out on the same carrier, and the correspondence procedure which separates the signal of all information sequences is examined. The channel formed between this transceiver antenna is called a MIMO (Multi-Input Multi-Output) channel, and when between channels is low correlation, high frequency use effectiveness can be realized.
However, the signal of other information sequences which share the same band serves as cochannel interference for the signal of a certain information sequence. Therefore, in a receiving set, it becomes indispensable to separate all information sequences with a sufficient precision.
A diversity reception method has the description which can separate an interference signal [being contained in an input signal (-one diversity reception signal)], and the signal of the information sequence of choice. Moreover, since the signal sharpness of separation of the signal of the information sequence of choice goes up and diversity gain is further acquired whenever the number of interference signals becomes fewer, the transmission quality improves.
However, it depends on a propagation environment for the correlation between the channels formed between transceiver antennas. For example, if between a mobile station and a base station serves as a line-of-sight communication environment, the correlation between input signals will become high. This is as equivalent as the number of diversity reception signals having become fewer, and when the interference signal with (-one diversity reception signal) other than the signal of the information sequence of choice is included in the input signal in this case, signal degree of separation deteriorate remarkably.
[0003]
It is received by each receiver, and weighting of each received signal is carried out under the weight, many weighting signals are generated, one or more of the signals by which weighting was carried out are put together, and many signals with which the outline of the signal separation approach in the conventional MIMO communication system includes a sending signal and many interference signals obtain one or more presumed sending signals (for example, patent reference 1. reference). Thus, each interference signal is effectually removable.
[0004]
[Patent reference 1]
JP,2002-84260,A (epitome) ( )

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EFFECT OF THE INVENTION

[Effect of the Invention]
As explained above, this invention measures correlation between the input signals of each information sequence. By generating the input-signal replica of the information sequence which extracted the information sequence signal sequentially from the signal of an information sequence with a small correlation value, and was extracted after extracting the signal of each information sequence, and repeating successively the processing subtracted from an input signal Signal degree of separation can be raised and an improvement of the transmission quality by improvement in SNR can be aimed at.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]
The signal of an information sequence with the small correlation between the input signals in two or more receiving antennas can improve [separation] precision with a diversity reception property, when there is a signal which is interfering into an input signal. Moreover, the transmission quality improves by the increment in the number of diversity branches (the number of input signals from an antenna). However, it depends on the environment of surrounding planimetric features, a building, etc. for the correlation between the channels formed between transceiver antennas. Therefore, it is difficult to secure the always required number of diversity reception signals. There is an ADAPUDIBU array technique as a technique which uses two or more input signals with the large correlation between input signals for an effective target, and raises the transmission quality. It is separable by forming null in the arrival direction of an interference signal with this technique. Moreover, only in the case of the signal of choice, the SNR can be raised. Since compensation by phasing generally observed by mobile communication environment is difficult, a property does not improve like a diversity reception method.
[0006]
In this invention, correlation between the input signals of each information sequence performs a signal extract in order with a diversity reception property from a small information sequence in MIMO communication system. Furthermore, the receiving replica of the signal of the extracted information sequence is subtracted from an input signal one by one. In case this processes the signal of an information sequence with the large correlation between input signals, since the signal of an information sequence with the small correlation between input signals is already removed from the signal used as a processing object, its transmission quality improves. According to the correlation value between input signals, suitable signal processing is serially performed to a target, and the construction of the receiving set which separates all User Information is offered.
[0007]

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MEANS

(Solution means)
[0005]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the communication system for which the receiving set of this invention is used.
[Drawing 2] Drawing showing the example of a configuration of a signal decollator.
[Drawing 3] Drawing showing the example of a configuration of a cross-correlation measuring instrument.
[Drawing 4] Drawing showing the example of a configuration of a signal eliminator.
[Drawing 5] Drawing showing the example of a configuration of a signal extractor.
[Drawing 6] Drawing showing the example of a configuration of a replica generation machine.
[Drawing 7] Drawing showing other examples of a configuration of a signal decollator.
[Drawing 8] Drawing showing the error rate BER property over the average reception SNR for every receiving network.

[Translation done.]